

## Bachelor's Track Program: Biology and Biotechnology

### 1. Open Doors winner's skill set

Winning the Open Doors competition requires a firm grasp of:

- concepts, terms, and patterns related to the functioning, growth, and development of organisms and biological systems;
- structure and functions of cells, tissues, and organs of plants, invertebrates, vertebrates, humans, and fungi;
- structural organization of bacteria and viruses;
- classification of living things;
- principles of evolution, heredity, and variability of organisms;
- fundamentals of biotechnology and its role in industry and medicine, including methods of gene and cell engineering and cloning of agricultural organisms.

The winner is expected to demonstrate a solid command of the following skills:

- analyzing the structure and functions of cells, tissues, and organs of plants, invertebrates, vertebrates, humans, and fungi;
- investigating the structural organization of bacteria and viruses;
- identifying characteristic features of the biochemistry, physiology, energy metabolism, reproduction, and ontogenesis of organisms;
- analyzing genetic processes and their applications in breeding.

### 2. List of degree programs covered by the subject area:

#### 2.1. List of Bachelor' degree programs

06.03.01. Biology

19.03.01 Biotechnology

#### 2.2 List of specialist's degree programs

06.05.01 Bioengineering and Bioinformatics

06.05.02 Fundamental and Applied Biology

### 3. Content

#### Field of science 1. Biology

##### Biology

1. Structure and functions of plant organs; classification of higher plants; life cycles.
2. Invertebrates: systematics, structure, vital activity, habitat, and way of life.
3. Vertebrates: systematics, structure, habitats, adaptations to way of life, and diversity.
4. Reproduction and individual development of organisms; types of reproduction; gametogenesis; ontogenesis.
5. Humans: structure and functions of organ systems and skin; behavior and mental state; human health.
6. Evolution: methods of evolutionary studies; micro- and macroevolution; factors, forms, and results of evolution; anthropogenesis.

#### Field of science 2. Biochemistry and molecular biology

##### Biology

1. Energy transfer. Protein synthesis.

##### Chemistry

2. Chemical components of the cell.

**Field of science 3. Microbiology****Biology**

1. Mold fungi, yeasts, and bacteria: structure, reproduction, diversity, and industrial use.
2. Chemosynthesis.
3. Types of fermentation.

**Field of science 4. Genetics and heredity****Biology**

1. Genetics: methods and patterns of inheritance of traits; genetics of sex.
2. Hereditary and non-hereditary variability. Human genetics.
3. Methods and achievements of plant and animal breeding.

**Field of science 5. Virology****Biology**

1. Viruses: structure, life cycle, and taxonomy; prevention of viral diseases.

**Field of science 6. Cell biology****Biology**

1. Structure of pro- and eukaryotic cells; cell cycle; mitosis and meiosis.
2. Plant tissues: types of tissues in the human body.

**Field of science 7. Biotechnology and applied microbiology****Chemistry**

1. Obtaining antibiotics, proteins, vitamins.
2. Theory of solutions, chemistry, and delivery of drugs.
3. Chemistry of biological polymers.

**Biology and Chemistry**

4. Biotechnology as a branch of industry.
5. Microbiology of food products.
6. Medical biotechnology

**4. Preparation materials****4.1. Recommended reading****Field of science 1. Biology****Reading list in English**

- |                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Freeman S. Biological science. – Pearson education, Inc., 2008.<br><a href="http://elibrary.mukuba.edu.zm:8080/jspui/handle/123456789/272">URL://http://elibrary.mukuba.edu.zm:8080/jspui/handle/123456789/272</a>                                                                                                            |
| 2. Sadava D. E., Hillis D. M., Heller H. C., Berenbaum M.R. Life: The science of biology. 9th ed, The Courier Companies, Inc. 2009, 1392 p.<br><a href="https://archive.org/details/LifeTheScienceOfBiology9thEd./page/n3/mode/2u">URL://https://archive.org/details/LifeTheScienceOfBiology9thEd./page/n3/mode/2u</a>           |
| 3. Taylor D. J., Green N. P. O., Stout W. Biological Science 1 and 2 3rd, Cambridge, 1997, Cambridge University Press; 3rd edition (November 28, 1997). 992 p<br><a href="https://archive.org/details/biologicalscienc0000djta/page/990/mode/2up">URL:https://archive.org/details/biologicalscienc0000djta/page/990/mode/2up</a> |

**Field of science 2. Biochemistry and molecular biology**

**Reading list in English**

1. Lehninger A. L., Nelson D. L., Cox M. M. Lehninger principles of biochemistry. Macmillan, 2005.  
[URL:https://archive.org/details/lehningerprincip0000lehn\\_04ed/page/n9/mode/2up](https://archive.org/details/lehningerprincip0000lehn_04ed/page/n9/mode/2up)
2. Title Berg J. M., Tymoczko J. L., Stryer L., Clarke N. D. Biochemistry. Vol. 5. New York: WH freeman, 2002.  
[URL:https://biokamikazi.wordpress.com/wp-content/uploads/2013/10/biochemistry-stryer-5th-ed.pdf](https://biokamikazi.wordpress.com/wp-content/uploads/2013/10/biochemistry-stryer-5th-ed.pdf)
3. Title Voet D., Voet J. G. Biochemistry. John Wiley & Sons, 2010  
[URL://https://books.google.ru/books?hl=ru&lr=&id=8mV19Jz\\_v4AC&oi=fnd&pg=PR1&dq=voet+biochemistry&ots=1E7NIQS08A&sig=wdJl4uRsedxYa39\\_9Bd7cz\\_CWAU&redir\\_esc=y#v=onepage&q=voet%20biochemistry&f=false](https://books.google.ru/books?hl=ru&lr=&id=8mV19Jz_v4AC&oi=fnd&pg=PR1&dq=voet+biochemistry&ots=1E7NIQS08A&sig=wdJl4uRsedxYa39_9Bd7cz_CWAU&redir_esc=y#v=onepage&q=voet%20biochemistry&f=false)

**Field of science 3. Microbiology****Reading list in English**

1. Taylor D. J., Green N. P. O., Stout W. Biological Science 1 and 2 3rd, Cambridge, 1997, Cambridge University Press; 3rd edition (November 28, 1997). 992 p  
[URL:https://archive.org/details/biologicalscienc0000djta/page/990/mode/2up](https://archive.org/details/biologicalscienc0000djta/page/990/mode/2up)
2. Title Prescott L. M. et al. Microbiology, 2002  
[URL:https://djvu.online/file/68zn1JYK5G67k](https://djvu.online/file/68zn1JYK5G67k)
3. Title Schlegel H. G., Zaborosch C. General microbiology. – Cambridge university press, 1993. [URL://https://archive.org/details/generalmicrobiol0000schl](https://archive.org/details/generalmicrobiol0000schl)

**Field of science 4. Genetics and heredity****Reading list in English**

1. Taylor D. J., Green N. P. O., Stout W. Biological Science 1 and 2 3rd, Cambridge, 1997, Cambridge University Press; 3rd edition (November 28, 1997). 992 p  
[URL:https://archive.org/details/biologicalscienc0000djta/page/990/mode/2up](https://archive.org/details/biologicalscienc0000djta/page/990/mode/2up)
2. Title Griffiths A.J.F., Wessler S.R., Carrol S.B., Doebley J. Introduction to genetic analysis, 10th edition, W. H. Freeman and Company, New York, 2012, 862 p.  
[URL:https://archive.org/details/introductiontoge0000grif/page/n903/mode/2up](https://archive.org/details/introductiontoge0000grif/page/n903/mode/2up)
3. Title Lewin B., Krebs J., Kilpatrick S. T., Goldstein E. S. Lewin's genes X. Jones & Bartlett Learning, 2011.  
[URL:https://books.google.com/books?hl=ru&lr=&id=0pM4KbFIEb0C&oi=fnd&pg=PP2&dq=Lewin+Genes&ots=57AcXiKBxG&sig=adTr6aWMbe-ETeDvClhwcIEMB1o](https://books.google.com/books?hl=ru&lr=&id=0pM4KbFIEb0C&oi=fnd&pg=PP2&dq=Lewin+Genes&ots=57AcXiKBxG&sig=adTr6aWMbe-ETeDvClhwcIEMB1o)

**Field of science 5. Virology****Reading list in English**

1. Freeman S. Biological science. – Pearson education, Inc., 2008.  
[URL:http://elibrary.mukuba.edu.zm:8080/jspui/handle/123456789/272](http://elibrary.mukuba.edu.zm:8080/jspui/handle/123456789/272)
2. Title Carter J., Saunders V. A. Virology: principles and applications. – John Wiley & Sons, 2007.  
[URL:https://www.pmf.unizg.hr/download/repository/Virology\\_Principles\\_and\\_Applications](https://www.pmf.unizg.hr/download/repository/Virology_Principles_and_Applications)

- J. Carter 2C V. Saunders 28Wiley 2C 2007 29 WW%5B3%5D.pdf
3. Title Dimmock N. J., Easton A. J., Leppard K. N. Introduction to modern virology. – John Wiley & Sons, 2015. URL: <a href="https://dpbck.ac.in/wp-content/uploads/2022/10/Introduction-to-Modern-Virology-PDFDrive-.pdf">https://dpbck.ac.in/wp-content/uploads/2022/10/Introduction-to-Modern-Virology-PDFDrive-.pdf</a>

## Field of science 6. Cell biology

Reading list in English
1. Pollard T. D., Earnshaw W. C., Lippincott-Schwartz J., Johnson G. Cell Biology E-Book. Elsevier Health Sciences, 2022. URL: <a href="https://archive.org/details/cellbiology0000poll_j2k6/page/n839/mode/2up">https://archive.org/details/cellbiology0000poll_j2k6/page/n839/mode/2up</a>
2. Title Alberts B., Bray D., Hopkin K., Johnson A. D., Lewis J., Raff M., Walter P. Essential cell biology. Garland Science, 2015 URL: <a href="https://archive.org/details/essentialcellbio0000albe/mode/2up">https://archive.org/details/essentialcellbio0000albe/mode/2up</a>
3. Title Lewin B. (ed.). Cells. – Jones & Bartlett Learning, 2007. URL: <a href="https://books.google.com/books?hl=ru&amp;lr=&amp;id=2VEGC8j9g9wC&amp;oi=fnd&amp;pg=PR3&amp;dq=Lewin+Cells&amp;ots=x091w5Ma4e&amp;sig=AUOaPYgIEI9RmcYHiP-QPYaGVg">https://books.google.com/books?hl=ru&amp;lr=&amp;id=2VEGC8j9g9wC&amp;oi=fnd&amp;pg=PR3&amp;dq=Lewin+Cells&amp;ots=x091w5Ma4e&amp;sig=AUOaPYgIEI9RmcYHiP-QPYaGVg</a>

## Field of science 7. Biotechnology and applied microbiology

Reading list in English
1. Title Renneberg R. Biotechnology for beginners. Academic Press, 2023. URL: <a href="https://archive.org/details/biotechnologyforb0000renn/mode/2up">https://archive.org/details/biotechnologyforb0000renn/mode/2up</a>
2. Title Dubey R. C. A textbook of Biotechnology. S. Chand Publishing, 1993. URL: <a href="https://books.google.ru/books?id=KKAwITRunZYC&amp;source=ttb&amp;redir_esc=y">https://books.google.ru/books?id=KKAwITRunZYC&amp;source=ttb&amp;redir_esc=y</a>
3. Khan F. A. Biotechnology Fundamentals Third Edition. CRC Press, 2020. URL: <a href="https://www.taylorfrancis.com/books/mono/10.1201/9781003024750/biotechnology-fundamentals-third-edition-firdos-alam-khan">https://www.taylorfrancis.com/books/mono/10.1201/9781003024750/biotechnology-fundamentals-third-edition-firdos-alam-khan</a>

## 4.2. Recommended online courses

### Field of science 1. Biology

Online courses in English	Link	Course description
Zygote Body 3D Anatomy Online Visualizer   Human Anatomy 3D	URL: <a href="https://www.zygotebody.com/">https://www.zygotebody.com/</a>	Students will benefit from this widely used interactive virtual anatomy software, which is medically accurate, visually engaging, clearly structured, and comprehensive.
Introduction to biology	URL: <a href="https://www.coursera.org/specializations/introduction-to-biology">https://www.coursera.org/specializations/introduction-to-biology</a>	This course fosters a deeper understanding of the complexities involved in recording observations, modeling ecosystems, generating and exploring ideas, interpreting

		phylogenetic trees, analyzing samples, studying scientific literature, and identifying species, while encouraging interdisciplinary thinking.
Introductory Biology	URL: <a href="https://ocw.mit.edu/courses/7-016-introductory-biology-fall-2018/video_galleries/lecture-videos">https://ocw.mit.edu/courses/7-016-introductory-biology-fall-2018/video_galleries/lecture-videos</a>	This course provides an introduction to the fundamental principles of biochemistry, molecular biology, and genetics, offering insight into the functioning of living systems.

## Field of science 2. Biochemistry and molecular biology

Online courses in English	Link	Course description
General Biochemistry	<a href="https://ocw.mit.edu/courses/7-05-general-biochemistry-spring-2020/">URL:https://ocw.mit.edu/courses/7-05-general-biochemistry-spring-2020/</a>	This course examines the contributions of biochemistry to understanding the structure and function of organisms, tissues, and cells. Topics include the chemistry and functions of cellular and tissue constituents; the chemical and physicochemical foundations of nucleic acids, proteins, and carbohydrates; fundamental enzymology and biochemical reaction mechanisms involved in macromolecular synthesis and degradation, signaling, transport, and movement; and the general metabolism of carbohydrates, fats, and nitrogen-containing compounds such as amino acids and proteins.
HarvardX: Principles of Biochemistry	<a href="https://www.harvardonline.harvard.edu/course/principles-biochemistry">URL://https://www.harvardonline.harvard.edu/course/principles-biochemistry</a>	This introduction to biochemistry explores the molecules of life, starting at simple building blocks and culminating in complex metabolism.
Selected Chapters of Biology and Chemistry	<a href="https://stepik.org/course/64583/promo?search=4753796738">URL://https://stepik.org/course/64583/promo?search=4753796738</a>	This course provides a fundamental understanding of biochemistry,

		emphasizing core concepts and offering a detailed exploration of the kinetics of biological reactions.
--	--	--------------------------------------------------------------------------------------------------------

### Field of science 3. Microbiology

Online courses in English	Link	Course description
HarvardX: Food Fermentation: The Science of Cooking with Microbes	<a href="https://www.edx.org/learn/cooking/harvard-university-food-fermentation-the-science-of-cooking-with-microbes">URL://https://www.edx.org/learn/cooking/harvard-university-food-fermentation-the-science-of-cooking-with-microbes</a>	This course analyzes the role of microbes in production, preservation, and enhancement of diverse foods across a variety of culinary traditions.
How we organize life to study them?—Class 11	<a href="https://www.khanacademy.org/science/biology-essentials">URL://https://www.khanacademy.org/science/biology-essentials</a>	This course provides an introduction to microbiology.
Bacteria and Chronic Infections	<a href="https://www.my-mooc.com/en/mooc/bacteria-and-chronic-infections">URL://https://www.my-mooc.com/en/mooc/bacteria-and-chronic-infections</a>	This course provides a foundational introduction to bacteria and the mechanisms underlying chronic infections. Leading experts present fundamental concepts in microbiology and bacteriology, including single-cell bacteria, biofilm formation, and the distinctions between acute and chronic infections.

### Field of science 4. Genetics and heredity

Online courses in English	Link	Course description
Biological Diversity	<a href="https://stepik.org/course/114959/promo">URL://https://stepik.org/course/114959/promo</a>	This course presents an overview of the theories underlying the evolution and dynamics of biological diversity, along with methods for its calculation and estimation.
Genetics & evolution	<a href="https://www.coursera.org/learn/genetics-evolution">URL://https://www.coursera.org/learn/genetics-evolution</a>	The course provides an introduction to genetics and evolution.
Introduction to biology	<a href="https://www.coursera.org/specializations/introduction-to-biology">URL://https://www.coursera.org/specializations/introduction-to-biology</a>	This course fosters a deeper understanding of the complexities involved in recording observations, modeling ecosystems, generating and exploring

		ideas, interpreting phylogenetic trees, analyzing samples, studying scientific literature, and identifying species, while encouraging interdisciplinary thinking.
--	--	-------------------------------------------------------------------------------------------------------------------------------------------------------------------

### Field of science 5. Virology

Online courses in English	Link	Course description
Viruses & How to Beat Them I: Introduction to Cell Biology & Viruses	URL: <a href="https://www.classcentral.com/course/cellular-biology-tel-aviv-university-viruses-how--184286">https://www.classcentral.com/course/cellular-biology-tel-aviv-university-viruses-how--184286</a>	This course provides an introduction to virology and cell biology.
Unit 22: Viruses	URL: <a href="https://www.khanacademy.org/science/biology/biology-of-viruses">https://www.khanacademy.org/science/biology/biology-of-viruses</a>	the course is designed to develop students' understanding of viruses. The structure of a virus and how it infects a cell.
Introductory Biology	URL: <a href="https://ocw.mit.edu/courses/7-016-introductory-biology-fall-2018/video_galleries/lecture-videos/">https://ocw.mit.edu/courses/7-016-introductory-biology-fall-2018/video_galleries/lecture-videos/</a>	This course introduces the fundamental principles of biochemistry, molecular biology, and genetics to foster an understanding of how living systems function.
Special microbiology	URL: <a href="https://sechenov.online/course/special-microbiology">https://sechenov.online/course/special-microbiology</a>	This course consists of several thematic units, focusing on hepatitis B, C, and D viruses, herpesviruses, and HIV.

### Field of science 6. Cell biology

Online courses in English	Link	Course description
Biology archive	URL: <a href="https://www.khanacademy.org/science/biology">https://www.khanacademy.org/science/biology</a>	The course covers an introduction to cells, emphasizing the history of their discovery and the development of cell theory. It also examines cell division and provides an overview of the main tissue types and organ systems of the body, highlighting their coordinated functions.
Introduction to biology	URL: <a href="https://ocw.mit.edu/courses/7-012-introduction-to-biology-fall-2004/">https://ocw.mit.edu/courses/7-012-introduction-to-biology-fall-2004/</a>	This course fosters a deeper understanding of the complexities involved in recording observations, modeling ecosystems,



		generating and exploring ideas, interpreting phylogenetic trees, analyzing samples, studying scientific literature, and identifying species, while encouraging interdisciplinary thinking.
Introductory Biology	<a href="https://ocw.mit.edu/courses/7-016-introductory-biology-fall-2018/video_galleries/lecture-videos/">URL:https://ocw.mit.edu/courses/7-016-introductory-biology-fall-2018/video_galleries/lecture-videos/</a>	This course provides an introduction to fundamental principles of biochemistry, molecular biology, and genetics to foster an understanding of how living systems function.

### Field of science 7. Biotechnology and applied microbiology

Online courses in English	Link	Course description
Industrial biotechnology	<a href="https://www.coursera.org/learn/industrial-biotech">URL:https://www.coursera.org/learn/industrial-biotech</a>	This course covers the technologies underlying biotechnological research, including the discovery and development of enzymes, systems and synthetic biology, as well as biochemical and technological engineering.
Industrial biotechnology	<a href="https://www.my-mooc.com/en/mooc/industrial-biotechnology">URL:https://www.my-mooc.com/en/mooc/industrial-biotechnology</a>	This course covers the key enabling technologies underpinning biotechnology research, including enzyme discovery and engineering, systems and synthetic biology, and biochemical and process engineering.
DelftX: Industrial Fermentation	<a href="https://www.classcentral.com/course/delftx-industrial-biotechnology-and-industrial-fe-207664">URL://https://www.classcentral.com/course/delftx-industrial-biotechnology-and-industrial-fe-207664</a>	This course explores the fundamentals of industrial fermentation processes, where microorganisms convert renewable feedstocks into biomaterials, chemicals, nutritional products, and biofuels.